CLAIMS

1. An isolated porcine adenovirus sequence essential for encapsidation that comprises a nucleotide sequence selected from the group consisting of AAATT; ATTTT; TATT; TATTTTTT; TATATA; TTTT; TATTTT; ATATT; TTTA; AATTTTA; ATTTTT; and TATTTATT.

2. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said nucleotide sequence comprises a nucleotide sequence selected from the group consisting of:

Motif I represented by X_IAAATTY$_I$, wherein X_I is selected from the group consisting of G, GG, CGG, GCGG, and GGCGG, and wherein Y_I is selected from the group consisting of CCCGCACA, CCCGCAC, CCCGCA, CCCGC, CCCG, CCC, CC and C;

Motif II represented by X_{II}ATTTTY$_{II}$, wherein X_{II} is selected from the group consisting of G, GG, GGG, CGGG, and GCGGG, and wherein Y_{II} is selected from the group consisting of GTGCCCTCT, GTGCCCTC, GTGCCCT, GTGCCC, GTGCC, GTGC, GTG, GT and G;

Motif III represented by X_{III}TATTY$_{III}$,wherein X_{III} is selected from the group consisting of G, GG, CGG, CCGG, and CCCGG, and wherein Y_{III} is selected from the group consisting of CCCCACCTG, CCCCACCT, CCCCACC, CCCCAC, CCCCA, CCCC, CCC, CC, and C;

Motif IV represented by X_{IV}TATTTTTTY$_{IV}$, wherein X_{IV} is selected from the group consisting of G, TG, GTG, GGTG, and GGGTG, and wherein Y_{IV} is selected from the group consisting of CCCCTCA, CCCCTC, CCCCT, CCCC, CCC, CC, and C;

Motif V represented by X_VTATATAY$_V$, wherein X_V is selected from the group consisting of G, TG, GTG, AGTG, and CAGTG, and wherein Y_V is selected from the group consisting of GTCCGCGC, GTCCGCG, GTCCGC, GTCCG, GTCC, GTC, GT and G; and

Motif VI represented by X_{VI}TTTTY$_{VI}$, wherein X_{VI} is selected from the group consisting of G, AG, GAG, AGAG, and TAGAG, wherein Y_{VI} is selected from the group consisting of CTCTCAGCG, CTCTCAGC, CTCTCAG, CTCTCA, CTCTC, CTCT, CTC, CT and C.

3. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said sequence comprises a nucleotide sequence selected from the group consisting of:

Motif 1 represented by X_1TATTTTY$_1$, wherein X_1 is selected from the group consisting of G, GG, TGG, and CTGG, and wherein Y_1 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 2 represented by X_2ATATTY$_2$, wherein X_2 is selected from the group consisting of G, TG, and GTG, and wherein Y_2 is selected from the group consisting of G and GG;

Motif 3 represented by X_3TTTAY$_3$, wherein X_3 is selected from the group consisting of C and CC, and wherein Y_3 is selected from the group consisting of C, CC, CCT, CCTG, CCTGG, and CCTGGG;

Motif 4 represented by X_4AATTTTAY$_4$, wherein X_4 is selected from the group consisting of C, TC, and CTC, and wherein Y_4 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 5 represented by X_5ATTTTTY$_5$, wherein X_5 is selected from the group consisting of G, CG, TCG, GTCG, and GGTCG, and wherein Y_5 is selected from the group consisting of C, CC, CCA, and CCAC; and

Motif 6 represented by X_6TATTTATTY$_6$, wherein X_6 is selected from the group consisting of C, CC, and CCC, and wherein Y_6 is selected from the group consisting of C, CT, CTG, CTGC, CTGCG, CTGCGC, and CTGCGCG.

4. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said sequence is a porcine adenovirus 3 sequence.

5. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said sequence is a porcine adenovirus 5 sequence.

6. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said sequence comprises a nucleotide sequence selected from the group consisting of:

CGGAAATTCCCGCACA; GGCGGAAATTCCCGCACA;
GGGATTTTGTGCCCTCT; GCGGGATTTTGTGCCCTCT
CGGTATTCCCCACCTG; CCCGGTATTCCCCACCTG

GTGTATTTTTTCCCCTCA; GGGTGTATTTTTTCCCCTCA
GTGTATATAGTCCGCGC; CAGTGTATATAGTCCGCGC;
GAGTTTTCTCTCAGCG; and TAGAGTTTTCTCTCAGCG.

7. The porcine adenovirus sequence essential for encapsidation of claim 1 wherein said sequence comprises a nucleotide sequence selected from the group consisting of:

CTGGTATTTTCCAC;
GTGATATTGG;
CCTTTACCTGGG;
CTCAATTTTACCAC;
GGTCGATTTTTCCAC; and
CCCTATTTATTCTGCGCG

8. A recombinant adenovirus vector comprising an isolated porcine adenovirus sequence essential for encapsidation that comprises a nucleotide sequence selected from the group consisting of AAATT; ATTTT; TATT; TATTTTTT; TATATA; TTTT; TATTTT; ATATT; TTTA; AATTTTA; ATTTTT; and TATTTATT.

9. The recombinant adenovirus vector of claim 8 wherein said porcine adenovirus sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of:

Motif I represented by X_IAAATTY$_I$, wherein X_I is selected from the group consisting of G, GG, CGG, GCGG, and GGCGG, and wherein Y_I is selected from the group consisting of CCCGCACA, CCCGCAC, CCCGCA, CCCGC, CCCG, CCC, CC and C;

Motif II represented by X_{II}ATTTTY$_{II}$, wherein X_{II} is selected from the group consisting of G, GG, GGG, CGGG, and GCGGG, and wherein Y_{II} is selected from the group consisting of GTGCCCTCT, GTGCCCTC, GTGCCCT, GTGCCC, GTGCC, GTGC, GTG, GT and G;

Motif III represented by X_{III}TATTY$_{III}$,wherein X_{III} is selected from the group consisting of G, GG, CGG, CCGG, and CCCGG, and wherein Y_{III} is selected from the group consisting of CCCCACCTG, CCCCACCT, CCCCACC, CCCCAC, CCCCA, CCCC, CCC, CC, and C;

Motif IV represented by X_{IV}TATTTTTTY$_{IV}$, wherein X_{IV} is selected from the group consisting of G, TG, GTG, GGTG, and GGGTG, and wherein Y_{IV} is selected from the group consisting of CCCCTCA, CCCCTC, CCCCT, CCCC, CCC, CC, and C;

Motif V represented by X_VTATATAY$_V$, wherein X_V is selected from the group consisting of G, TG, GTG, AGTG, and CAGTG, and wherein Y_V is selected from the group consisting of GTCCGCGC, GTCCGCG, GTCCGC, GTCCG, GTCC, GTC, GT and G; and

Motif VI represented by X_{VI}TTTTY$_{VI}$, wherein X_{VI} is selected from the group consisting of G, AG, GAG, AGAG, and TAGAG, wherein Y_{VI} is selected from the group consisting of CTCTCAGCG, CTCTCAGC, CTCTCAG, CTCTCA, CTCTC, CTCT, CTC, CT and C.

10. The recombinant adenovirus vector of claim 8 wherein said porcine adenovirus sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of:

Motif 1 represented by X_1TATTTTY$_1$, wherein X_1 is selected from the group consisting of G, GG, TGG, and CTGG, and wherein Y_1 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 2 represented by X_2ATATTY$_2$, wherein X_2 is selected from the group consisting of G, TG, and GTG, and wherein Y_2 is selected from the group consisting of G and GG;

Motif 3 represented by X_3TTTAY$_3$, wherein X_3 is selected from the group consisting of C and CC, and wherein Y_3 is selected from the group consisting of C, CC, CCT, CCTG, CCTGG, and CCTGGG;

Motif 4 represented by X_4AATTTTAY$_4$, wherein X_4 is selected from the group consisting of C, TC, and CTC, and wherein Y_4 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 5 represented by X_5ATTTTTY$_5$, wherein X_5 is selected from the group consisting of G, CG, TCG, GTCG, and GGTCG, and wherein Y_5 is selected from the group consisting of C, CC, CCA, and CCAC; and

Motif 6 represented by X_6TATTTATTY$_6$, wherein X_6 is selected from the group consisting of C, CC, and CCC, and wherein Y_6 is selected from the group consisting of C, CT, CTG, CTGC, CTGCG, CTGCGC, and CTGCGCG.

11. A replication-defective recombinant adenovirus vector which comprises an isolated porcine adenovirus sequence(s) essential for encapsidation, wherein said sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of AAATT; ATTTT; TATT; TATTTTTT; TATATA; TTTT; TATTTT; ATATT; TTTA; AATTTTA; ATTTTT; and TATTTATT.

12. The recombinant adenovirus vector of claim 11, wherein said porcine adenovirus sequence(s) essential for encapsidation is heterologous to said adenovirus vector.

13. The recombinant adenovirus vector of claim 12 wherein said adenovirus vector comprises human adenoviral sequences.

14. The recombinant adenovirus vector of claim 12 wherein said adenovirus vector comprises bovine adenoviral sequences.

15. The recombinant adenovirus vector of claim 11 wherein said sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of:

Motif I represented by X_IAAATTY$_I$, wherein X_I is selected from the group consisting of G, GG, CGG, GCGG, and GGCGG, and wherein Y_I is selected from the group consisting of CCCGCACA, CCCGCAC, CCCGCA, CCCGC, CCCG, CCC, CC and C;

Motif II represented by X_{II}ATTTTY$_{II}$, wherein X_{II} is selected from the group consisting of G, GG, GGG, CGGG, and GCGGG, and wherein Y_{II} is selected from the group consisting of GTGCCCTCT, GTGCCCTC, GTGCCCT, GTGCCC, GTGCC, GTGC, GTG, GT and G;

Motif III represented by X_{III}TATTY$_{III}$,wherein X_{III} is selected from the group consisting of G, GG, CGG, CCGG, and CCCGG, and wherein Y_{III} is selected from the group consisting of CCCCACCTG, CCCCACCT, CCCCACC, CCCCAC, CCCCA, CCCC, CCC, CC, and C;

Motif IV represented by X_{IV}TATTTTTTY$_{IV}$, wherein X_{IV} is selected from the group consisting of G, TG, GTG, GGTG, and GGGTG, and wherein Y_{IV} is selected from the group consisting of CCCCTCA, CCCCTC, CCCCT, CCCC, CCC, CC, and C;

Motif V represented by $X_VTATATAY_V$, wherein X_V is selected from the group consisting of G, TG, GTG, AGTG, and CAGTG, and wherein Y_V is selected from the group consisting of GTCCGCGC, GTCCGCG, GTCCGC, GTCCG, GTCC, GTC, GT and G; and

Motif VI represented by $X_{VI}TTTTY_{VI}$, wherein X_{VI} is selected from the group consisting of G, AG, GAG, AGAG, and TAGAG, wherein Y_{VI} is selected from the group consisting of CTCTCAGCG, CTCTCAGC, CTCTCAG, CTCTCA, CTCTC, CTCT, CTC, CT and C.

16. The recombinant adenovirus vector of claim 11 wherein said porcine adenovirus sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of:

Motif 1 represented by $X_1TATTTTY_1$, wherein X_1 is selected from the group consisting of G, GG, TGG, and CTGG, and wherein Y_1 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 2 represented by $X_2ATATTY_2$, wherein X_2 is selected from the group consisting of G, TG, and GTG, and wherein Y_2 is selected from the group consisting of G and GG;

Motif 3 represented by X_3TTTAY_3, wherein X_3 is selected from the group consisting of C and CC, and wherein Y_3 is selected from the group consisting of C, CC, CCT, CCTG, CCTGG, and CCTGGG;

Motif 4 represented by $X_4AATTTTAY_4$, wherein X_4 is selected from the group consisting of C, TC, and CTC, and wherein Y_4 is selected from the group consisting of C, CC, CCA, and CCAC;

Motif 5 represented by $X_5ATTTTTY_5$, wherein X_5 is selected from the group consisting of G, CG, TCG, GTCG, and GGTCG, and wherein Y_5 is selected from the group consisting of C, CC, CCA, and CCAC; and

Motif 6 represented by $X_6TATTTATTY_6$, wherein X_6 is selected from the group consisting of C, CC, and CCC, and wherein Y_6 is selected from the group consisting of C, CT, CTG, CTGC, CTGCG, CTGCGC, and CTGCGCG.

17. The recombinant adenovirus vector of claim 11 which further comprises at least one nucleic acid sequence encoding a transgene.

18. The recombinant vector of claim 11 which further comprises at least one inverted terminal repeat sequence from a human adenovirus.

19. The recombinant vector of claim 11 which further comprises at least one inverted terminal repeat sequence from a bovine adenovirus.

20. The recombinant adenovirus vector of claim 11 wherein said adenovirus vector comprises at least one isolated porcine adenovirus sequence(s) essential for encapsidation, at least one inverted terminal repeat sequence and nucleic acid encoding a transgene, wherein said adenovirus vector is deleted in a nucleic acid sequence encoding an adenovirus protein.

21. The recombinant adenovirus vector of claim 12, wherein said adenovirus vector comprises a human adenovirus sequence, a porcine adenovirus sequence, or bovine adenovirus sequences.

22. The recombinant adenovirus vector of claim 20 wherein said transgene encodes an immunogenic polypeptide.

23. The recombinant adenovirus vector of claim 20 wherein said transgene encodes an antigen of a pathogen.

24. The recombinant adenovirus vector of claim 23 wherein said pathogen is a human pathogen.

25. The recombinant adenovirus vector of claim 23 wherein said pathogen includes a bovine pathogen, porcine pathogen, canine pathogen, feline pathogen or equine pathogen.

26. A recombinant porcine adenovirus vector which comprises a deletion of a porcine adenovirus sequence essential for encapsidation, wherein said sequence essential for encapsidation comprises a nucleotide sequence selected from the group consisting of AAATT; ATTTT; TATT; TATTTTTT; TATATA; TTTT; TATTTT; ATATT; TTTA; AATTTTA; ATTTTT; and TATTTATT.

27. The recombinant porcine adenovirus vector of claim 26 wherein said porcine adenovirus is PAV3.

28. The recombinant porcine adenovirus vector of claim 26 wherein said porcine adenovirus is PAV5.

29. A host cell comprising the adenovirus vector of claim 11.

30. A host cell comprising the adenovirus vector of claim 26.

31. The host cell of claim 29 which is mammalian.

32. The host cell of claim 30 which is mammalian.

33. A recombinant adenovirus particle comprising the adenovirus vector of claim 11.

34. A recombinant adenovirus particle comprising the adenovirus vector of claim 26.

35. A composition comprising the adenoviral vector of claims 11.

36. A composition comprising the adenoviral vector of claims 26.

37. The composition of claim 35 further comprising a pharmaceutically acceptable carrier.

38. The composition of claim 35 or 36 further comprising a pharmaceutically acceptable carrier.

39. A composition capable of inducing an immune response in a mammalian subject, said composition comprising an adenovirus vector of claim 11 or claim 26 and a pharmaceutically acceptable excipient.

40. A method for eliciting an immune response in a mammalian subject comprising administering a composition of claim 35 and a pharmaceutically acceptable excipient to said mammalian subject.

41. A method for eliciting an immune response in a mammalian subject comprising administering a composition of claim 36 and a pharmaceutically acceptable excipient to said mammalian subject.

42. A recombinant porcine adenovirus vector comprising a deletion and/or addition of part or all of one or more E1 transcriptional control regions.

43. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 252 to about nucleotide 313 of PAV-3.

44. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 382 to about nucleotide 433 of PAV-3.

45. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 432 to about nucleotide 449 of PAV-3.

46. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 312 to about nucleotide 382 of PAV-3.

47. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 312 to about nucleotide 449 of PAV-3.

48. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 252 to about nucleotide 449 of PAV-3.

49. The recombinant porcine adenovirus vector of claim 42 wherein said E1 transcriptional control region comprises from about nucleotide 371 to about nucleotide 432 of PAV-3.

50. A host cell comprising a porcine adenovirus vector of claim 42.

51. A composition comprising a porcine adenovirus vector of claim 42.

52. The composition of claim 51 further comprising a pharmaceutically acceptable carrier.

53. A recombinant adenovirus particle comprising the adenovirus vector of claim 42.

54. A composition capable of inducing an immune response in a mammalian subject, said composition comprising an adenovirus vector of claim 42 and a pharmaceutically acceptable excipient.

55. A method for eliciting an immune response in an mammalian subject comprising administering a composition of claim 42 and a pharmaceutically acceptable excipient to said mammalian subject.

56. A vaccine for protecting a mammalian host against infection comprising the recombinant adenovirus vector of claim 11 and a pharmaceutically acceptable excipient.

57. A vaccine for protecting a mammalian host against infection comprising the recombinant adenovirus vector of claim 26 and a pharmaceutically acceptable excipient.

58. A vaccine for protecting a mammalian host against infection comprising the recombinant adenovirus vector of claim 42 and a pharmaceutically acceptable excipient.

59. A method for preparing a porcine adenovirus comprising, culturing a recombinant porcine adenovirus vector which is deleted in a porcine adenovirus sequence(s) essential for encapsidation, such that the vector is not capable of being encapsidated, wherein said adenovirus vector is optionally deleted in nucleic acid encoding adenoviral proteins necessary for replication; in the presence of a helper virus that comprises nucleic acid for the porcine adenovirus sequence essential for encapsidation and optionally any adenovirus protein necessary for replication of said adenovirus, under conditions suitable for production of viral particles; and optionally recovering said viral particles.

60. A method for preparing an adenovirus comprising culturing an adenovirus vector which comprises a porcine adenovirus sequence(s) essential for encapsidation, wherein said porcine adenovirus sequence(s) essential for encapsidation is heterologous to said adenovirus vector, under conditions suitable for production of viral particles; and optionally recovering said viral particles.

61. A method for preparing an adenovirus comprising culturing an adenovirus vector which comprises a deletion and/or addition of part or all of one or more E1 transcriptional control regions comprising culturing the adenovirus vector under conditions suitable for production of viral particles; and optionally recovering said viral particles.

62. The method of claim 59 wherein said adenovirus vector further comprises a transgene.

63. The method of claim 60 wherein said adenovirus vector further comprises a transgene.

64. The method of claim 61 wherein said adenovirus vector further comprises a transgene.